Discovering Hidden Analogies in an Online Humanities Database*

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ABSTRACT

VOLUMINOUS DATABASES CONTAIN HIDDEN KNOWLEDGE—i.e., literatures that are logically but not bibliographically linked. Unlinked literatures containing academically interesting commonalities cannot be retrieved via normal searching methods. Extracting hidden knowledge from humanities databases is especially problematic because the literature, written in "everyday" rather than technical language, lacks the precision required for efficient retrieval, and because humanities scholars seek new analogies rather than causes. Drawing upon an efficacious method for discovering previously unknown causes of medical syndromes and searching in the Humanities Index, a periodical index included in WILS, the Wilson Database, an illuminating new humanities analogy was found by constructing a search statement in which proper names were coupled with associated concepts.

PROBLEM STATEMENT

Journal articles are logically linked if they deal with the same subject(s). If, within online databases, their citations share common terms, they are also bibliographically linked. Retrieving them is simply a matter of inputting a common term. Unfortunately, many logically connected citations lack common terms. Conventional searching methods cannot retrieve these "noninteractive" citations. Swanson (1986b, 1988), working in medical databases, developed a novel searching technique that retrieved hidden

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knowledge—i.e., logically connected but bibliographically unconnected citations. The intent of this study was to determine if humanists could apply Swanson's methodology.

Extracting hidden knowledge from humanities databases is problematic because the literature, written in "everyday" rather than technical language, lacks the precision required for efficient retrieval, and because humanists more often seek new analogies rather than causes. This researcher overcame those obstacles by constructing a search statement in which proper names were coupled with associated concepts. The discovery of a previously unnoticed analogy between the epistemological ideas of Robert Frost and the ancient Greek philosopher Carneades suggests that the voluminous contents of online databases may collectively be a new kind of primary source.

Discovering new humanities knowledge is crucially important because humanities scholars rarely have access to new information sources. Natural and social scientists create new knowledge via experimentation. The latter also rely on surveys. And from economic, political, and social statistics, they have replenishing sources on which to base novel conclusions. Humanists rely on primary sources, something not available in humanities databases. Therefore, if humanists could "create" new knowledge by finding links between and among existing citations, that would accelerate their research efforts.

Accelerating the research process is also a practical necessity. Online searching is expensive. Telecommunication connect charges consume roughly half the cost of all searches and apply even when nothing of value is found. Researchers would value any technique, however imperfect, that cost-effectively retrieves worthwhile citations.

Scholars of different humanities disciplines consult different databases, each of which has its idiosyncrasies. To ensure that database peculiarities would not confound the research findings, this study was focused on finding new knowledge in a single electronic literary database.

Theoretical Framework

Summarizing arguments from philosophy and information science, Davies (1989) concluded that the sum of the world's knowledge is vastly more than the sum of all knowledge within publications. Potentially, each concept can generate logical consequences, the results of which cannot be anticipated. This implies the existence of hidden knowledge within databases.

Swanson (1986a, 1986b, 1988, 1989a, 1989b, 1990a, 1990b, 1991, 1993) published a remarkable series of papers calling attention to this reality by finding previously unknown causes of medical syndromes. His success and his challenge to librarians to develop searching methods to find other logically linked noninteractive documents inspired this study. Obviously,

if electronic medical databases contain vast quantities of undiscovered knowledge, so may all large electronic databases, including those in the humanities.

Two Inherent Problems

In planning this study, considerable doubt existed that Swanson's procedure would yield new humanities knowledge. One major problem involves the nature of words appearing in bibliographic citations. In Swanson's methodology, searchers must retrieve a large number of titles in order to identify frequently reappearing words. These words must be specific and descriptive. Because medical terminology is technical and technical terms tend to lack synonyms, medical titles tend to be descriptive of an article's contents. This is a convention of all technical literature. Humanities titles often are nondescriptive, even imaginative. There are few technical terms, and synonyms abound for almost every word. Benaud and Bordeinanu (1995) describe the problem succinctly:

> Several factors make database searching in the humanities particularly difficult. Chief among these is the semantic ambiguity attached to many humanistic terms. The high occurrence of natural language in humanistic writing that impedes the selection of index terms also presents difficulties for bibliographic retrieval. For example, the title *The Mirror and the Lamp*, written by M. H. Abrams in 1953, would not alert the database searcher that he found a work on romantic theory and the critical tradition. (pp. 42-43)

A second problem inheres in the differing nature of the knowledge sought. Medical researchers commonly look for causes. In contrast, humanistic researchers, especially those seeking literary knowledge, commonly seek to provide new interpretations. Stone (1982), explaining the tendency of humanists to work alone, emphasized that "the individual scholar's interpretation is paramount" (p. 294). The subjective nature of an interpretation renders empirical verification moot. Instead, as reported by Wiberley (1991), peer acceptance is the normal criterion of an interpretation. One could say that peer confirmation is the equivalent of hypothesis confirmation in the sciences. For these reasons, information scientists hoping to discover significant new humanities knowledge are seeking intrinsically elusive material. They can do no more than call attention to information appearing to support new interpretations.

Focusing on Hidden Analogies

Because analogies often establish illuminating interpretations, seeking new interpretations commonly requires seeking analogous materials. Analogies are the "comparison of two things, alike in certain respects; particularly a method of exposition by which one unfamiliar object or idea is explained by comparing it to something more familiar" (Holman

& Harmon, 1992, p. 20). The practical value of finding a hidden analogy between certain authors is that knowing the ideas of one may help explain similar ideas of the other.

As humanists know, the weakness of an analogy is that few different objects or ideas are essentially the same to more than a superficial observer or thinker (Holman & Harmon, 1992). Nevertheless, though often meaningless, analogies occasionally form the basis of new interpretations.

Considerable searching failed to locate any systematic attempts to discover hidden analogies. Davies (1989), in his delineation of the categories of hidden knowledge, mentioned that Farradane, as early as 1961, hoped that relational indexing might be developed that would be capable of "recognizing analogies between subjects." Davies (1989) provided a reason to believe that hidden analogies could be found. "According to von Bertalanffy, there are many instances where identical principles were discovered several times because the workers in one field were unaware that the theoretical structure required was already well developed in some other field" (p. 284). Davies's conviction that hidden analogies could be discovered encouraged this investigator to believe that shifting the focus from causation to analogies could uncover hidden knowledge in humanities databases.

Limitations

There are limitations to using analogies:

1. Analogies are subjective concepts. They cannot be laboratory tested. Therefore, any report of new knowledge must be understood as tentative—something appearing to be significant and worth pursuing by humanist scholars.
2. Replication may produce nothing of value. A method is verified if identical results are consistently produced from identical testing conditions. Replicating the method employed in the following search procedure may produce an analogous relationship, but that relationship may not be meaningful.
3. Database searching is an inexact science. Success is partially dependent on the educational level and intelligent imagination of the searcher.
4. Searching for analogies may only be successful when the search is phrased in terms of "Who or what influenced someone or something?" Influence questions are essentially causal in nature. And, as Swanson has demonstrated, unknown causes can be discovered.

Research Methodology

Because of Swanson's success, and because the method he employed to search for hidden transitive relations is also recommended by Davies

(1989) for finding hidden analogies, this researcher proceeded from that method while searching for hidden analogous knowledge in the humanities. This systematic trial-and-error strategy was best described by Davies (1989):

1. A search statement is constructed based on the subject under investigation.
2. A lengthy list of title citations is retrieved.
3. Titles are examined for recurring words or phrases. These words or phrases must not be synonymous with the original subject.
4. These recurring terms are used, one at a time, to construct a search statement for a second round of searching. In the second round, the original search term is omitted from the search statement.
5. The resulting titles are examined. Here, the researcher makes a strategic guess. Articles with titles that seem logically related to the original subject are retrieved and read. The researcher attempts to determine whether or not the contents of particular articles might significantly illuminate the original subject. If so,
6. The researcher attempts to determine whether or not an article is bibliographically linked to the original subject. As described below, this is done by conventional searching (p. 294).

A Specific Example of the Swanson Method Applied to a Medical Database

Swanson identified magnesium deficiency as a causal agent in the occurrence of migraine headaches. At that time, the causes of migraine headaches were unknown.

His original search term was "migraine." That produced a plethora of title citations containing "migraine." These were examined for recurring words or phrases. Among these were "calcium entry blockers" and "platelets." They were included in a second round of searching in which migraine was omitted. Eventually, searching produced several sets of citations, with two citations in each set. In each of the first list of titles, "migraine" appeared, along with a chemical or condition known to be present in migraine sufferers. In each of the second list of titles of the corresponding set, the same chemical or condition appeared but not migraine. In the following examples, note that magnesium is not mentioned in relation to migraines but does appear in reference to a condition known to be associated with migraine:

a: Role of *calcium entry blockers* in the prophylaxis of migraine
b: Magnesium: nature's physiologic *calcium blocker*

a: Evidence of enhanced *platelet aggression* in platelet sensitivity in migraine patients
b: Protective effects of dietary calcium and magnesium on *platelet* function

Swanson (1993) concluded: "Because of the shared 'linkage' terms shown in italics, each of the. . . pairs of titles raises the question of whether magnesium deficiency might be implicated in migraine." He labeled these sets "'complementary literatures,' [or] a pair in which one literature appears to contain a potential solution to a problem posed in the other" (p. 620). Bringing together complementary citations allows even a nonexpert to notice a possible causal relationship. Eventually, one must read the articles. Merely matching citations is insufficient.

Application of Swanson's Methodology to Humanities Databases

Overcoming the Limitations of Humanities Language

Because of the "ordinary language" found in humanities citations, a searching method had to be developed using substitutes for recurring words and phrases. The one type of recurring term found in humanities citations for which there are virtually no synonyms is names.

Using Names to Control Imprecise Searches

Names meet the crucial criteria of Swanson's searching method: they recur and, because they commonly refer to a single person, they are specific. Names are not ambiguous. Names have no synonyms. Of course, a name may be logically linked to more than a single concept. Searching with "wagner, richard" might retrieve citations pertaining to the development of the leitmotif, Tannhauser, or revolutionary activity in nineteenth-century Germany. Admittedly, names do lack the precision of medical terms. Nevertheless, using names to construct search statements considerably reduces the ambiguity inherent in humanities terminology. Tibbo (1991) quotes Wiberley who, "in a study of terms taken from encyclopedias and dictionaries in the humanities, confirms the importance of singular proper terms, especially the names of persons. He concludes that subject access is far more straightforward than has been recognized if subjects are expressed through such proper names" (p. 300).

Because names are often associated with multiple concepts, they cannot, by themselves, be used as search statements when attempting to discover new knowledge. However, when names are associated with specific concepts, they can serve as controlling terms that direct a second round of searching.

The following is a detailed example of how three graduate students discovered a new analogy. Note a major departure from Swanson's method. These researchers did not look for recurring words or phrases. Any name, even if mentioned only once, may be profitably used in the second round of searching. The important precepts are to: (1) couple the name with an associated concept, and (2) omit the original term in the second searching round.

Carneades/William James/Robert Frost

Methodology

Responding to an inquiry about Robert Frost (1874-1963), student researchers produced several citations pertaining to the nineteenth-century American pragmatic philosopher, William James (1842-1910). Subsequent reading revealed that Robert Frost had definite philosophical convictions pertaining to how truths can be verified. His ideas were influenced by James, so much so that knowing the underlying philosophy of James clarifies the epistemological ideas of Frost.

An intriguing question evolved: Could there be an unknown literary or philosophical antecedent of James, the discovery of whom might assist in understanding Frost? Certainly humanists are aware that the works of Frost are a compendium of the works of earlier thinkers in addition to James. Even those who may not have shaped Frost's thinking directly may have had a significant influence and would thus be worth knowing about because they can assist one to understand Frost's ideas. The question became: What author(s) not known to have directly influenced Frost's poetry have nonetheless indirectly influenced it via someone else? Would knowing the ideas of this author contribute to a better understanding of Frost?

Frost became the *C* in the equation: Unknown author *(A)* → James *(B)* → Frost *(C)*. The algebraic equation, If $A = B$, and $B = C$, then $A = C$, is true for numbers. For humanities connections, it is sometimes meaningful but usually not. Nevertheless, it is a worthwhile mental model for seeking logical connections among citations.

Results from preliminary searching indicated that the most promising database was the Humanities Index, one of eight periodical indexes included in the Wilson database, also known as WILS. The Modern Language Association's MLA-CD was rejected as it lacks pure philosophy, which limits its usefulness for searching about William James. The Humanities Index was selected because of the breadth of its contents: folklore, history, language and literature, literary and political criticism, performing arts, philosophy, and religion and theology. Coverage is extensive with articles from over 1,000 periodicals indexed. Moreover, its time coverage, 1983 to the present, is fairly lengthy and is updated monthly.

In the second round of searching, the name "William James" was employed. The intention was to retrieve names associated with James that would suggest promising avenues of additional searching. As stated above, the retrieved names must be associated not only with the subject under investigation—i.e., James—they must also be coupled with a concept common to Frost and James. After reading that Frost's interest in James was epistemological—i.e., he accepted James's methods of verifying ideas—epistemology was chosen as the associated concept. The search statement was "james and epistemology." That produced only thirty useful citations. The search needed to be broadened. Clearly, "epistemology"

by itself was insufficient. A quick inquiry into a standard reference source was informative. James's epistemological thinking led him to pragmatism. Therefore, pragmatism was included in the next search (Duran, 1953, pp. 510-13). The search statement "james and (epistemology or pragmatism)" produced eighty citations.

Retrieved titles not containing a name associated with James were eliminated. Forty-four citations containing names associated with James and pragmatism looked promising. These included: Carneades (circa 214-129 BCE), Bernard of Clairvaux (eleventh century), John Dewey (1859-1952), and C. S. Pierce (1839-1914). Conventional searching—i.e., a keyword search: "k = [name of an author appearing in a retrieved citation] and frost" demonstrated that there were bibliographic links between Frost and the other authors except Carneades.

Two citations seemed promising. One indicated a logical link between the pragmatic philosophy of Carneades and James and the other indicated a logical link between the pragmatic philosophy of James and Frost. These formed a set:

- Doty, R. (1986). "Carneades, a forerunner of William James's pragmatism." *Journal of the History of Ideas, 47*(1), 133-138.
- Shaw, W. D. (1986). "The poetics of pragmatism: Robert Frost and William James." *The New England Quarterly, 59*(2), 159-188.

Note that "James" and "pragmatism" appear in each citation. Also, note that "Carneades" appears as a forerunner of James and James appears as a forerunner of Frost. All three names are logically linked to pragmatism with William James being common to both. Reading the articles verified that both dealt with epistemological subjects. These citations are bibliographically unlinked as indicated by the fact that nothing in the Doty article refers to Frost; nothing in the Shaw article refers to Carneades. Therefore, conventional searching could not retrieve these citations together. That is, searching by "frost, robert" would retrieve citations pertaining to James but not to Carneades.

Next, the searchers had to determine if the logical connection was already known. They determined that it was not, by searching to see if either of the authors of the set cited each other (Doty citing Shaw or Shaw citing Doty in an article(s) about Carneades and Frost). Also, they checked to see if any third author cited both of them (x cites both Doty and Shaw in an article about either Frost or Carneades). Because both searches produced negative hits, the connection was presumed to be unknown among academicians.

Analysis of the Articles

Briefly analyzing the retrieved articles helps one appreciate the necessity of subjective insight. Although there is an efficacious methodology

to report, its efficacy depends upon a well-educated searcher. In the humanities, a single name, identified as relevant, can uncover a significant analogy provided that the searcher can perceive a logical link between citations. A searcher need not be a refined scholar, but he or she must be academically knowledgeable.

Carneades, James, and Frost

Doty (1986) contends that Carneades and James developed comparable theories of truth. Doty found no evidence proving that James had read Carneades. He accounts for their parallelism by proposing that both men faced similar opponents and reacted in like fashion. Carneades founded the New Academy, which espoused skepticism as an alternative to stoicism. Similarly, James, reacting against rationalist philosophy, developed his theory of pragmatism.

Carneades believed that individuals do not perceive certainty or "truth" in their experiences—or at least what they believe to be truth. In order to determine the validity of experience, Carneades developed three criteria: the probable, the irreversible, and the tested. These criteria parallel James's correspondence test of truth, coherence test, and pragmatic truth-test. Thus, both men "present a truth-test consisting of the verification of a hypothesis by empirical methods" (p. 136). However, James's test is one of truth presumed to be knowable, and truth for him is the product of empirical verification. Carneades, on the other hand, rejects truth as being beyond human knowing and offers a test of probability. Despite that difference, Doty's article clearly establishes a logical link between Carneades and James.

Next, reading Shaw's (1986) essay described how James influenced Frost. Frost had extensively read James. Frost's poems often explored the consequences of James's pragmatic concept of truth. To Frost, the "possession of true thoughts means everywhere the possession of invaluable instruments of action" (quoted in Shaw, 1986, p. 161). Shaw contends that one of the most prominent features of this definition is the impossibility of developing a philosophically or critically interesting theory concerning the dictionary or essential meaning of a word. This establishes an apparent congruence of thought between Carneades and Frost. Further reading revealed that, throughout the poems of debate, Frost has one of his characters substitute a blueprint for action for a conventional dictionary definition. This corresponds to a statement of James's about being lost in the woods and how the true thought of a house is useful "because the house which is its object is useful" (quoted in Shaw, 1986, p. 162).

James did not believe that a pragmatic definition required an experiment to prove that it was true, and Frost exemplifies this concept in a number of poems such as "The Mountain." In this poem, Frost has his farmer establish conditions under which his statement could be verified—yet he does not then actually have the farmer verify the statement.

James often used the term "tough-minded" to describe the skeptical and empirical temperament that he admired. In his poems, Frost shows "tough-minded" speakers (i.e., skeptics) debating with what he called "tender-minded" speakers who were dogmatic idealists. Frost parallels James in his belief that "all attempts to ground practice in traditional theology or metaphysics are attempts to make a god-term of some useless wheel that plays no active part in the cosmic mechanism" (Shaw, 1986, p. 175). Frost exhibits this belief in several poems, most notably in "A Masque of Mercy" and "A Masque of Reason." He argues instead for a workable theism that possesses three qualities in which he believed. Theism, Frost proposed, must be open and free, must be plural, and must be purposive and partly intelligible.

Frost and James also agree upon the notion of freedom. Both believe that freedom exists only when one has to make choices that will produce results that are mutually exclusive. This is evident in "The Road Not Taken." In what are collectively called his poems of departure, Frost also shows the benefits and problems of having the freedom to choose.

The searchers concluded by postulating a logical connection between Carneades and Frost. They reported that Carneades's three criteria are similar to James's three tests of truth. Furthermore, Frost utilized those tests in his poetry. For example, the farmer in "The Mountain" employs two of Carneades's criteria when he sees a stream (the probable) and discusses the possibility of it originating at the top of the mountain (the irreversible). Thus it seems possible to analyze Frost's poetry by employing Carneades's method of verification.

The student researchers were academically reluctant to insist that their finding qualified as an important new analogy. They did claim, and justifiably in the opinion of their professor, sufficient grounds for recommending that humanist scholars read Carneades's works and compare them to the poetry of Frost. The novel idea that the epistemological tests of an obscure ancient Greek may serve as an illuminating philosophical prefigurement of Frost's epistemology does seem worth pursuing. More importantly, whatever the scholarly value of this particular finding, the fact that a previously unrealized analogy has been discovered establishes the efficacy of the described searching method.

Preliminary Conclusion

This study had two objectives: (1) to develop a methodology that would accelerate humanities research by discovering significant hidden analogies within electronic humanities databases; (2) to prove the efficacy of that method by actually discovering a significant analogy that could not be discovered by means of conventional searching.

The result was encouraging. The investigators did link logically related citations that were bibliographically unlinked. "Related" is a subjective

decision, but the principal investigator is confident that sufficient supporting evidence was furnished to make a reasonable case that an important analogy was discovered. And, of course, the primary objective of this project was not to actually discover hidden knowledge but to discover a means of accelerating humanities research via online searching. That has been accomplished.

In any discipline, the possibility of discovering hidden or unlinked knowledge offers improved services, substantial financial savings as compared with trial and error research, and increased status for librarians involved in successful searching. Moreover, for researchers who enjoy both searching challenges and academic subject matter, searching for undiscovered public knowledge offers a new source of personal intellectual excitement.

Future Plans and Recommendations for Future Research

Additional searches are required to confirm and to refine the method in various humanities disciplines. Librarians and/or information scientists are invited to apply Swanson's method or the variation described herein in all subject disciplines, including the natural and social sciences. If, as has been demonstrated in this study, the method can work for humanities topics, it can certainly be employed in disciplines using more technical terminology and in which causation is an important question.

This author is active in the imaging industry. Imaging is the conversion of information from paper, microform, photographic, or voice format into digital format. Imaging vendors are constructing a multitude of large business, scientific, and technical databases that will contain more information than can be retrieved by engaging conventional searching methods. Especially for companies involved in solving technical or environmental problems, information managers searching for new knowledge will find unexpected benefits. Eventually, online databases may be perceived less as static information repositories and more as knowledge generating machines.

Concluding Note

The student investigator, Mark Bowden, offered an appropriate concluding perspective:

> Perhaps humanities scholars will find the greatest benefit of this method is the way it orients one's view of a subject toward aspects or relationships previously unknown. New investigative avenues are opened, new hypotheses are formulated, and new syntheses proposed. At the very least it is a method for scholars to devise original research ideas; at the most it is a powerful tool for revealing hidden connections between persons, places, and events.

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